

Student society based learning

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Structured abstract

CONTEXT

The recently established Australian Maritime College Autonomous Technology (AMCAT) society is student driven and focuses on autonomous technologies in maritime environments. This is a recently established focus of study at the Australian Maritime College (AMC) which is a specialist institute of the University of Tasmania. The society developed from the existing program in which students develop underwater vehicles. Since inception, the integration of autonomous technologies into the AMC curriculum has been moved forward. The establishment of a society enables students to participate in relevant projects and strengthen their technical and communications skills such as code development, model production, hydrodynamic concepts, teamwork development, and oral communication which are core to the graduate attributes. This society is unique in the fact that it is exclusively student driven with guidance provided by specialised staff mentors when requested. Due to this, the direction of AMCAT is subject to student interests and student led initiatives. Within two months of the society being chartered, AMCAT has enhanced student involvement in the alteration of curricula, development of technology for Antarctic research and the initiation of a national underwater vehicle competition.

PURPOSE

The purpose of establishing AMCAT was to provide students with the opportunity to further investigate the autonomous technology and associated disciplines whilst being a part of a team environment comprised of peers. AMCAT also provided a unique platform upon which students could freely develop skills of their choosing without the pressures related to formative assessment.

APPROACH

Prior to the formation of this society, three students were given the opportunity of developing an autonomous technology project as a part time endeavour in 2012. As the project progressed, it became evident that the resource management and the complex range of tasks required the input of additional students. As the scope expanded, the decision to form a structured society was reached. A structured society also brought university and potential industry recognition with the benefits of financial support and sponsorships for the advancement of future projects.

ACTUAL OR ANTICIPATED OUTCOMES

Since April 17th 2013, the initial work of the founding members has attracted seed funding from the University of California – Davis (USA) and University of Canterbury (NZ) for the design and development of a prototype position tracking technology to be used on scuba divers. The future vision of AMCAT includes the establishment of Australia's first national AUV competition and to create a database, specific to underwater autonomous technology, available to current and future students interested in underwater technologies.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

Within the context of the Australian Maritime College, the benefits of the student led AMCAT society has already been demonstrated through the high standards of coding, design work, communication and project planning skills shown by the participating student body. In a relatively short time period, this society has given the opportunity for many students to apply themselves and engage in extracurricular activities and higher order learning experiences that may otherwise be unavailable.

KEYWORDS

Autonomous Technology, student-driven society

Introduction

Traditionally, higher education has been about the development of discipline knowledge and skills; however, some attributes require an approach that is impractical in a classroom environment as Radloff (2008) points out:

Traditionally most academic staff focus more on discipline content than on graduate attributes, with assessment tasks focusing mainly on '...the products of learning' rather than on the '...how and why' of what is to be learned.

For example, content-based learning is effective in a structured classroom environment, whereas student leadership skills may thrive where an authoritative staff influence is absent. This poses the question of how to provide a learning environment that concurrently eliminates factors that can potentially reduce a student's desire to learn and provides an environment that caters for advanced learning. The Australian Maritime College Autonomous Technology (AMCAT) society, whilst mentored by faculty, is student driven and is developed to accentuate graduate attributes. These attributes are essential for graduates to effectively transition into a professional engineering workplace environment.

At the Australian Maritime College (AMC), the degree attributes define the course objectives and are the intended final learning outcomes of a graduate, thus defining them as a goal or milestone for both current and future students to aspire to. This makes degree attributes critical to the AMC staff and students and thus requires a high degree of inspection and maintenance. Degree attributes are the foundation of an educational course to which the curricula seeks to impose upon a student. The attributes are governed by the relevant industry demand of the graduates in a symbiotic relationship "...professional competence has always been the ultimate goal of engineering curricula" (Lemaitre, 2006).

The Australian Maritime College's Graduate Attributes may be separated into the two classes, *Generic Attributes* and *Disciplinary Attributes* in accordance with the attribute classification in 'Beyond mapping and embedding graduate attributes' (Bath, 2004). Disciplinary Attributes are specific to certain courses, such as the ability to demonstrate technical knowledge of subsea installations by an Ocean Engineering graduate versus the ability to perform hull structural analysis by a Naval Architecture student. These attributes are recognised as teachable through conventional practice; this is discussed in the statement from Bath (2004):

This distinction between disciplinary skills (vocational skills) and general skills (transferable skills) has meant that the latter has tended to be taught implicitly and informally.

On the other hand, a generic attribute such as the ability to "motivate and mentor others, and accept mentoring from others" (AMC, 2013) may be encouraged by group based work but ultimately must be developed by the student. At the end of their courses, successful graduates must display both sets of attributes.

The professional accreditation body, Engineers Australia (The Institute of Engineers Australia) sets directives for the teaching, learning and assessment of Generic Attributes in Australian undergraduate engineering courses. In turn, a number of competency standards and Graduate Attributes have been established by Engineers Australia for the standardization of undergraduate students throughout their period of study (Engineers Australia, 2011)

Whilst developing new teaching practices, the analysis of the effectiveness of the new developments must be concurrently evaluated. Existing structured assessment may have a detrimental effect upon the development of certain attributes. An example of this is the limitations of an assessable project when compared to a realistic engineering project;

assessments are generally limited by the medium of a submissible report, Clark (2010) states that, "Real industry projects and teamwork can enhance student learning and commitment, but cause complications for academic assessment..." A proposed solution to this opposing dichotomy is the creation of a student driven society, which fosters student innovation through self-assessment.

Although elimination of formative degree-specific assessment may remove the pressures that extinguish the desire to learn, self-assessment within the societal frame is seen as essential to the development of generic attributes. Without self-assessment, one may not recognise the benefits of being a part of the society. After self-assessment has been performed, a tailoring of an individual's direction within a society can be performed. The AMCAT society is a potential environment where this could be achieved.

A student based society provides a foundation on which the participating students may build upon. This paper sets out to identify the framework and functions of a society and the framework to enable the analysis of its contribution to the improvement of the participating students learning experience both in the short and long term. Success metrics of the society are based upon the student's self-assessment, trends in membership application rates and the research progress reports produced by members.

Methodology

De la Harpe and Radloff (2008) comment on the implementation of methods to develop graduate attributes which all require the involvement of academic staff. However, as Harpe and Radloff further state, "...we conclude that to date outcomes across the sector have not been as promising as expected." (De la Harpe, 2008). Therefore, to investigate the effect of graduate development without direct influence of academic staff a student environment needs to be tailored to ensure specific graduate attributes could potentially be developed and quantified.

This method of using students to work towards society goals such as inter-institutional competitions (Bowden Floyd, 2013), reworking of university-based projects, design and construction of commercial prototypes and the production of a student society database provides AMCAT members with a wide range of problem solving situations.

The society seeks projects for its members through a variety of sources including AMC staff, relevant societies and course projects. An example of such is the involvement in the ROBOTX Singapore challenge which stemmed from a relationship with Flinders University and Industry contacts of AMC staff members. The ROBOTX challenge involves the development of an autonomous surface vessel capable of performing a variety of navigational tasks and competing against fourteen teams from five countries making it an ideal platform for AMCAT's advancement. Such a project presented an opportunity to broaden the AMCAT knowledge base through interaction with external groups and allow access to financial support and facilities. AMCAT members have since become responsible for the propulsion and hydrodynamic aspects of the vessel's design while liaising with the programming departments headed by the Flinders unit. The generic and disciplinary skills required to complete these tasks, will be developed and improved in the process of completing society work.

"Generic skills are most effectively developed when they are embedded in curricula in ways that give them discipline-nuanced expression." (Bath, 2004), meaning an engineering student will develop such skill sets when applying them directly within an engineering project. Graduate attributes that are considered integral in the workplace include generic skills which are deemed transferable regardless of course and disciplinary skills which are directly relevant to area of study. In accordance to a report conducted by AC Nielson Research entitled Employer Satisfaction with Graduate Skills (DETYA, 2000), attributes which are deemed important and 'sought in new graduates..' include oral communication skills, interpersonal skills, teamwork skills, problem solving skills, research and analysis

skills, leadership skills as well as comprehension of business processes. To ensure AMCAT aids in the development of these skill sets, which are oftentimes hard to assess directly in a classroom setting, the society helps develop projects directly targeted at underwater technologies to strengthen the link between disciplinary and generic skills.

Bath (2004) queries the way in which graduate attributes can be quantified to ensure development of such skills are occurring successfully and questions “Is there alignment between what is espoused, what is enacted and what students experience and learn? And how would we know when that alignment exists?”

The development of AMCAT society aims to resolve such questions through the investigations into the effectiveness of a student driven society. Quantification of self-development can be limiting as attempting to develop metrics of how a student-led society develops graduate attributes is difficult. One method is the use of social media (e.g., Facebook), web statistics and trends in student involvement. These can be used to obtain a general consensus of how the current members feel that they are benefiting from their involvement.

Attendance and membership data recorded from the start date of AMCAT society can be used to identify trends which indicate the effectiveness of the student society to attract member involvement and attentiveness. Trends in the members generic skills of team work, communication and management, can also be drawn from this.

AMCAT society's record of activities and involvements also serves as an indication of how successful a society is with regards to student based learning and development. The number of AMCAT members involved in society based projects since induction in April can suggest the engagement levels of most society members and thus whether the Society is successfully aiding in the development of graduate attributes and self-initiative learning.

These methods are preliminary approaches to assess the effectiveness of a student based society and its effects regarding member development of graduate attributes specified by AMC (2013) and the Australian Engineering Stage 1 Competency Standards (Engineers Australia, 2011). Such approaches need to be repeated, refined and recorded to create sufficient information regarding a positive and successful development of generic and disciplinary graduate attributes.

Results and discussion

Assessment in an area of generic attribute study such as communication, management and effective team working capabilities does not provide accurate measurements regarding the level of ability within such skill sets and thus the ways in which the development of graduate attributes is measured is constantly being investigated and updated. As Hammer (2009) states, “Many Australian academics have yet to develop clear strategies for developing and assessing attributes within their specific disciplinary context”

Therefore, using the theory that although direct measurement of self-development cannot be recorded but instead may be assessed using a broader spectrum via the methods above, the following results were obtained and used in the investigations of attribute development within a society based environment.

Since society induction on April 17th, active AMCAT membership numbers have been steadily increasing, as shown in Figure 1, until the 14th July where a sudden jump of membership numbers is seen to take place. This trend is replicated by the Facebook membership data with the sudden increase possibly due to a number of reasons including; AMCAT advertisement through lecturers, existing members and peers, public forums (such as Facebook), AMCAT involvement in A²UV competition, RobotX competition and 2nd year submarine project re-development as well as AMCAT awareness and relevance from engineering students post programming and submarine projects.

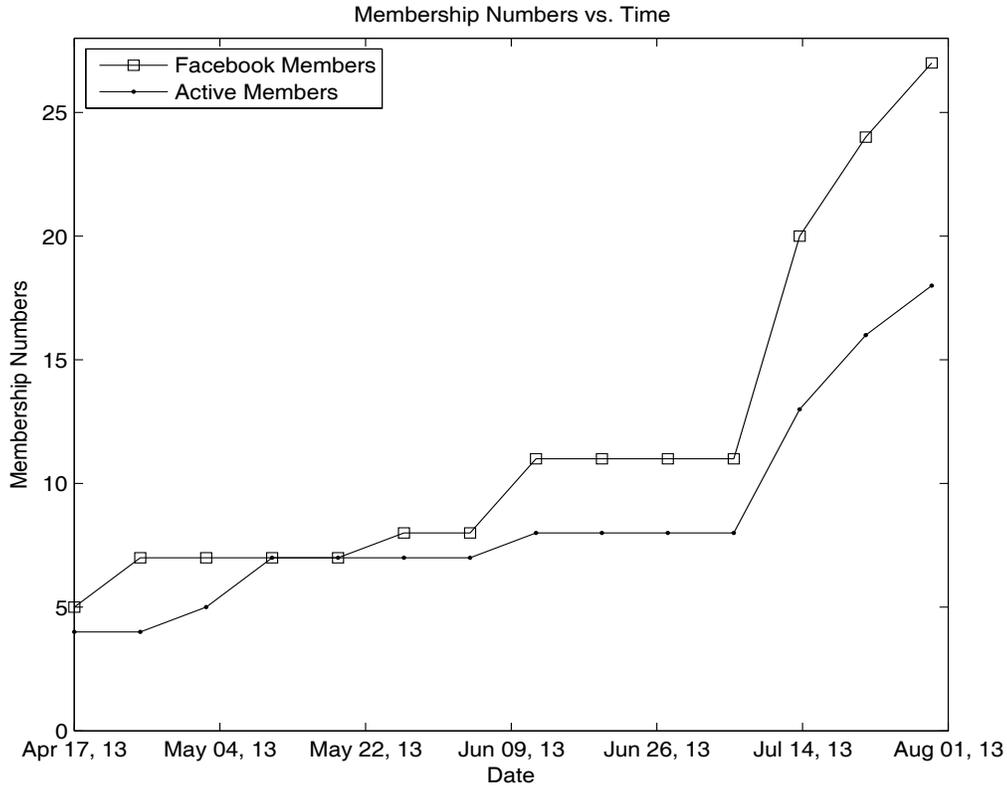


Figure 1: AMCAT membership data since April 17th, 2013

Since induction on the 17th April 2013, AMCAT society has involved itself through many important and prestigious activities as shown below in Table 1. Such activities include not just internal university projects but also inter-university competitions as well as a design/construction project delegated by the research department of the University of Southern California.

AMCAT involvement can be seen to increase from 3 members to approximately 27 members actively participating in society projects, which indicates that throughout AMCAT society's life, a trend of increasing demand with regards to project development has increased with the membership growth. This membership data along with increasing project involvement suggests that the society is successfully engaging the students and thus encouraging self-initiative and development. As Krause (2005) states:

The word 'engagement' has been used to describe a myriad of student behaviours and attitudes which are deemed essential to a high quality undergraduate learning experience.

Table 1: AMCAT Involvement and Results

Involved AMCAT Members	Project Title	Outcomes	Relationships Formed
3	Antarctic Black Box project	<ul style="list-style-type: none"> • Device that will be tested in Antarctica in December, fully student developed • Possible patents to be 	<ul style="list-style-type: none"> • Funded by University of Southern California with strong ties formed • Further contact and industry ties with Antarctic

		made	Biologists
3	S.M.A.R.T Sub	<ul style="list-style-type: none"> Autonomous AUV concept developed within 1 summer break 	<ul style="list-style-type: none"> Close relationship with students and staff of the AMC Contact and relationship formed with other students at universities such as Virginia Tech, USA.
3	Society of Underwater Technology (SUT)	<ul style="list-style-type: none"> Starting a long term relationship with SUT Retrieval of conferences run by SUT recorded for AMCAT members 	<ul style="list-style-type: none"> Relationship formed with SUT
12	A ² UV Competition	<ul style="list-style-type: none"> The development of an Inter-Institutional AUV competition Two conference papers, enhancing AMCAT's credibility 	<ul style="list-style-type: none"> Relationship formed with Multiple Australian Universities
≈27	RobotX Competition	<ul style="list-style-type: none"> The development of the propulsion system of an autonomous boat Further credibility for AMCAT and its members Publicity and sponsorship opportunities for AMCAT and the AMC 	<ul style="list-style-type: none"> Strengthened ties with Flinders University (Combined team)

With reference to the projects in Table 1, it can be observed that the nature of the projects over time has expanded to larger team based projects with strong emphasis on communication with inter-state and international entities. With the exception of exchange student programs, such a broad consultancy range is extremely rare in a classroom environment. Furthermore, the initiation of these contacts was sought by the members themselves with minimal guidance from teaching staff as opposed to being facilitated by administrative personnel as is the norm. This level of communicative skill is rarely attained in standard teaching environments and thus the benefits of graduate attribute developments are clear.

In addition, the ability to navigate interpersonal and inter-institutional relationships for transition into an industry environment is also being addressed through the formation of the competitions. By facilitating a competition the students are not only charged with the responsibilities of competing but are also involved in the projects administrative aspects. This may be compared to contracting work in industry; competing in the competition is similar to providing a product to the contracting company where the initial product advertisement and appraisal may be compared to the administrative work involved with initial set up of the competition.

The natural occurrence of leadership structure was also apparent during the adoption of new projects; initially a hierarchal structure was avoided for ethical reasons, however with increasing project size the necessity for an authoritative structure became apparent. This allowance for natural hierarchal development served as an excellent learning tool for leadership skills throughout the society. Ideally, future projects will service those who joined later once they have a sufficient knowledge base for a leadership role.

The ability to establish/discover such projects, engage AMCAT members to participate and complete tasks successfully shows that research and analysis skills as well as interpersonal, teamwork, communication, leaderships and problem solving skills are constantly being utilized and enhanced.

Conclusions

As Adams and Felder (2008) stated:

The embodiment of graduate attributes in the university teaching and learning experience has stood out as a major challenge for the higher education sector in the UK, US and Australasia.

Competency in generic and disciplinary skills is vital for a successful graduate transition and an effective contribution to their chosen field of work. To ensure the attributes described in both the Australian Engineering Stage 1 Competency Standards (Engineers Australia, 2011) as well as the Australian Maritime Colleges Bachelor of Engineering Degree Attributes (AMC, 2013) are achieved by graduates, further methods of student self-development need to be investigated. A proposed method of introducing a student based society was conducted at the AMC where the effects upon participating students can be assessed and quantified. A student based society void of staff authority, creates an environment where students are required to set their own guidelines and meet objective under their own accord. Such situations encourage self-development in the required generic and disciplinary skills including communicative, leadership, project management, teamwork and problem solving abilities which are otherwise difficult to evaluate in a standard classroom environment.

AMCAT Society has been shown to provide an environment where students are able to demonstrate and improve such skill sets through the use of university based and inter-institutional projects and competitions. The positive response to the induction of AMCAT has been shown through the increase in memberships and number of project acquisitions suggesting a strong trend between society based learning of student self-development and their awareness of the graduate attributes in place.

Further investigation in to the effect of a student based society would be beneficial to the understanding of student skill development and the ways in which they can be enhanced. Such investigations could potentially include annual evaluations of the society's expansion and effect upon the student community and participating members. Comparison of members and non-member students in performance external to the society (both university based and future employment) could be conducted to evaluate long term effects.

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